6.0 Summary

The distribution of habitats and HCP species in King and southern Snohomish County that have been proposed for coverage under Section 10 of the Endangered Species Act have been documented in this report. The report artificially divides the region from Mukilteo to the middle of Vashon Island into three areas: Brightwater Outfall Siting Area, WTD Existing Discharges Area, and Vashon Island Area (see Figure 1-1). These areas are based on the potential location of the new wastewater treatment facility outfall in Puget Sound and the presence of existing wastewater treatment division outfalls and discharges.

Marine organisms, be they mammals, birds, fish, or invertebrates, make no distinction among the three areas. Most of the species proposed for coverage are mobile and some may use the three areas for feeding, resting, spawning, access to spawning grounds, or access to feeding grounds. The three habitats types discussed in this report, including the supralittoral, intertidal and shallow subtidal, and deep subtidal, provide feeding and spawning areas for many of the species under consideration for the HCP. Each of these habitats, in one way or another supports the food webs that sustain the majority of the 41 species discussed in this report. These habitats represent natural gradations in the marine environment, each containing its own dominant species and structural and functional characteristics.

The following discussion synthesizes and summarizes existing data for the habitat types found in all three MHR study areas. Habitat usage and the distribution of the HCP species in the three study areas are also summarized. Available information for several species, including the harbor porpoise, northern abalone, Olympia oyster, eulachon, widow rockfish, blue rockfish, china rockfish, tiger rockfish, and canary rockfish, indicates that these species are either not found at all in the three study areas or occur so rarely that their distribution is unknown. As a result of this lack of information, these species are not discussed in this section of the report.

6.1 Supralittoral (>+3Meters)

The supralittoral zone, often referred to as the marine "riparian" zone, includes trees, shrubs, and dune grasses which serve to protect the upland property from erosion and to provide shade to the upper intertidal zone. The presence of the vegetation moderates temperatures and provides habitat for insects that are fed upon by juvenile salmonids. Many of the shorelines in the study area have not been extensively studied; however, aerial surveys have been conducted by WDOE and WDNR (WDNR 1999). Although these surveys do not provide detailed information, they do show that vegetation along undisturbed shorelines often consists of trees such as Douglas fir and alder. WDNR data (WDNR 1999)

indicate that the supralittoral zone in the Brightwater Outfall Siting Area is predominantly bordered by seawall (mostly in the form of railroad grade and riprap) with some overhanging vegetation occurring in some of the areas. There are some beach areas in the Brightwater Outfall Siting Area, such as around stream mouths (Picnic Point Creek, Lunds Gulch, Boeing Creek and Piper's Creek). WDNR data show that the supralittoral zone in the WTD Existing Discharges Area is bordered by seawall to a far greater extent than in the Brightwater Outfall Siting Area. There is a minor amount of armoring and treed shoreline near West Point, and the supralittoral zone from West Point to Magnolia consists of very high bluffs. The armoring is far greater in inner Elliott Bay where no natural shoreline currently exists. There are areas of overhanging vegetation in some of the areas bordered by seawalls from Alki Point to the southern edge of the WTD Existing Discharges Area. As compared to the Brightwater and WTD Existing Discharges Areas, the Vashon Island Area contains much less armored shoreline, with the majority of armoring occurring in the Seahurst region. Much of the eastern shoreline of Vashon Island is unmodified, and consists of areas with overhanging trees on low to moderately high bluffs.

The supralittoral zone is important to many of the HCP species as it can provide resting habitat or be a source of food and detrital material into the nearshore environment. The supralittoral zone is seldom used by the marine mammals and birds listed in this report except as possible haul out areas by sea lions (jetties) and resting areas for harlequin ducks. Steller sea lions are known to haul out on jetties in the supralittoral zone and a Steller sea lion has been seen on the Shilshole Marina jetty in the WTD Existing Discharges Area. The importance of the supralittoral zone to juvenile salmonids is becoming more apparent as the database on their habits increase. Juveniles of all species migrate past these areas at extreme high tides, feeding on insects and their larvae (see Appendix A). Although none of the groundfish or rockfish species proposed for coverage have been documented to utilize the supralittoral zone for spawning or feeding, two species of forage fish (sand lance and surf smelt) use habitat greater than +3 MLLW as spawning grounds. There are documented sand lance and surf smelt spawning grounds in all three-study areas (WDFW 1992).

6.2 Intertidal – Shallow Subtidal (-30 to +3 Meters)

The intertidal-shallow subtidal habitats within the study area consist largely of soft substrate with some areas of rocky substrate. The zone extends from the highest reaches of the intertidal zone down to the maximum depth at which macroscopic benthic plants are found (photic zone). The upper elevations on rocky shorelines generally contains rock weed (*Fucus distichus*), which is a stable component of rocky shore habitats and is known to harbor numerous species of gammarid and caprellid amphipods, small crabs and gastropods.

Fucus sp. is common but patchy throughout the Brightwater and WTD Existing Discharges Areas, and along the eastside of East Passage in the Vashon Island Area. It is also common along the western shoreline of Vashon Island along Colvos Passage, but uncommon on the eastern shoreline where the predominant substrate type is sand.

Mid and lower intertidal areas are characterized by sea lettuce (*Ulva* spp.), and the brown algae *Laminaria* spp. The shallow subtidal zone in rocky areas also contains *Laminaria* spp. as well as kelp forests (*Nereocystis luetkeana*). Kelp forests are often sites of congregation of adult and juvenile fishes, especially rockfish. *Ulva* spp. is found almost continuously from the north end of the Brightwater Outfall Siting Area to the south end of the Vashon Island Area. It is found in rocky habitats as well as in areas with sand or a combination of sand, gravel and cobble. *Laminaria* spp., on the other hand, is present but rare in the Brightwater Outfall Siting Area but common with a patchy distribution in the low intertidal-shallow subtidal zones in the WTD Existing Discharges and Vashon Island Areas (see Laminaria Figures 3-5, 4-5, 5-6). Eelgrass (*Zostera marina*), which forms meadows in the low intertidal and shallow subtidal zone in the region, is common but patchy in the intertidal zone of the Brightwater Outfall Siting Area and moderate to dense in the shallow subtidal zone. In the WTD Existing Discharges Area the intertidal eelgrass is common but patchy. Eelgrass is common in the Vashon Island Area with patchy meadows on the west, north and east sides of the area. Together, the eelgrass meadows and tidal flats form an extremely important feeding and rearing habitat for juvenile salmon. Eelgrass meadows harbor large number of fish species and often contain juvenile Dungeness crab and salmonids in very high numbers (Simenstad et al. 1991).

While whales and porpoises do not use the intertidal zone, seals and sea lions are known to use haul out areas in the intertidal zone. However, there were no documented occurrences of Steller sea lions using the intertidal zone in any of the three areas. Orcas may use the shallow subtidal zone for feeding and as a pathway to other feeding areas. Orcas have been sighted in all three study areas, particularly in the fall months when salmon are returning to their natal streams (K. Koski, Whale Museum, pers. comm.). Steller sea lions may use the shallow subtidal zone in all three areas for feeding on small schooling fishes and Pacific hake and as a migratory pathway (Gearin et al. 1999). In addition, Steller sea lions have been known to use a navigational buoy anchored in the shallow subtidal zone in the WTD Existing Discharges Area as a haul out site (M. Lance, WDFW, pers. comm.).

All three marine birds proposed for coverage in this report have been seen in low and varying numbers all along the shoreline in the study area. While all three species may be found feeding in intertidal and shallow subtidal habitats, harlequin ducks are the most likely to be seen in intertidal areas (Robertson and Goudie 1999). All three species of birds feed to some extent on small fishes, molluscs, crabs, and other crustaceans, which can be found in kelp beds and eelgrass meadows.

The importance of the intertidal-shallow subtidal zone to juvenile and adult salmonids cannot be overstated. Juveniles of all species migrate through, feed in, and use these areas for shelter. At high tide, gammarid amphipods, harpacticoid copepods, and some epibenthic zooplankton emerge from the shelter of rockweed, *Fucus* sp., and *Laminaria* spp. beds to be fed upon by juvenile chinook and chum salmon and cutthroat trout (see Appendix A). Coho salmon are less reliant than other salmonid species on benthic and epibenthic organisms for food because they tend to feed upon planktonic crustaceans and larger coho feed upon bait and forage fish (see Appendix A). Juvenile bull trout, sockeye salmon, and steelhead trout may also feed in these areas as well as using eelgrass meadows, *Laminaria* spp., and kelp beds as refuges. Juvenile chinook, chum, and coho salmon have been noted in the intertidal-shallow subtidal zone for all three areas. Juvenile steelhead trout have been found in the intertidal-shallow subtidal zone in the Brightwater Outfall Siting Area and the WTD Existing Discharges Area and juvenile cutthroat trout and sockeye salmon have been found in the WTD Existing Discharges Area (Mavros and Brennan, in prep.). However, the lack of juvenile salmonids in certain portions of the study area does not preclude these species from inhabiting these areas, but is a reflection of limited surveys and information. Adults of all salmonid species may feed in the kelp beds and eelgrass meadows due to the wide variety of prey items found in these areas. Adults are opportunistic feeders and prey on similar food items, such as small schooling fishes, Pacific hake, and scorpaenids (Emmett et al. 1991). Adults of all salmonid species, with the exception of bull trout and sockeye salmon, are known or are likely to use this zone in all three study areas. Sockeye salmon are known to use waters in the Brightwater Outfall Siting Area and the WTD Existing Discharges Area, but have not been documented in the Vashon Island Area. Bull trout have been documented in the WTD Existing Discharges Area but information in the other two areas is lacking.

The two lamprey species (Pacific and river) are known to inhabit the waters of Puget Sound but little information is known about their abundance and distribution. The river and stream habitats in the region contain suitable areas for both species, and it is likely that they pass through the intertidal-shallow subtidal zone as they migrate to Puget Sound. Their distribution within the study area is unknown.

There has been no confirmed sighting of either green or white sturgeon in Puget Sound since the 1970s. Miller and Borton (1980) reported two green and two white sturgeons in Puget Sound, however the locations of these sightings were not reported. Their life history indicates that they spawn and breed in the large rivers of the Oregon and Washington coast (mainly the Columbia River and tributaries) where they are commercially fished. Both juveniles and adults are benthic feeders, preying on worms, crustaceans, molluscs, and small fish (Emmett et al. 1991). Records indicate that these species typically feed in shallow subtidal waters at the mouths of large rivers. The absence of information on their distribution in Puget Sound does not indicate their absence, but a lack of concerted surveys to confirm or deny their presence.

Pacific cod have declined severely in the Puget Sound region since the 1980s. The northern Puget Sound population is considered to be depressed and the southern Puget Sound population is considered critical. Declining populations may be the result of fishing pressures and long-term cycles in Puget Sound water temperatures (Palsson et al. 1997). This species is found throughout the MHR study area, and uses the shallow subtidal zone for spawning, rearing, and feeding. Juveniles can be often found in eelgrass meadows where they feed on crabs, shrimp, snails, and small fish. Adults are demersal and usually found in the deep subtidal; however, they will migrate to shallow areas to feed. Adults feed on euphausids, shrimp, and both demersal and pelagic fish such as juvenile flatfish, sand lance, and Pacific herring (West 1997).

Walleye pollock were once the most common species caught recreationally in Puget Sound. In the 1980's, walleye pollock abundance declined sharply largely due to natural mortalities and fishing pressures (Schmitt et al. 1994). Pollock are present throughout Puget Sound (although they are more abundant in north and central Sound) and are found in all three study areas. Juveniles are semi-demersal and occupy inshore, shallow habitats in their first year of life. They settle in areas with eelgrass, gravel and cobble substrate. In their second year of life, juvenile pollock move to deeper subtidal waters, occupying mid-water and near-bottom habitat near sandy or muddy substrates (Schmitt et al. 1994).

The Pacific hake population in Puget Sound is considered to be at a critical level as its abundance has declined since the 1980s, likely due to over harvesting (Palsson et al. 1997). Pacific hake are a mid-water schooling species that undergoes northward feeding migrations to Washington and British Columbia in the summer, before return to southerly waters for winter spawning (West 1997). Juveniles may use nearshore and shallow subtidal areas for rearing before moving into deeper subtidal waters, although information on their distribution in nearshore areas is lacking. Adult hake are found in all three of the study areas but mainly in subtidal areas.

Lingcod populations have declined in recent years due mainly to over-harvesting by commercial and sport fisheries (Schmitt et al. 1994). Larvae and juveniles use nearshore intertidal and shallow subtidal habitats. Juveniles settle out in shallow water vegetated habitats, such as eelgrass and kelp beds (West 1997). Adults are demersal and are found in both shallow subtidal to deep subtidal rocky habitats. Adults feed on juvenile rockfish, cephalopods, gastropods, and crustaceans. Lingcod occur throughout Puget Sound and have been found in the Brightwater Outfall Siting Area and the WTD Existing Discharges Area (WDFW 2000). They have not been documented in the Vashon Island area although it is likely they also occur in this region.

Three of the four forage fish species proposed for coverage in the HCP have been documented in all three MHR areas: Pacific herring, sand lance and surf smelt. Pacific herring use the lower intertidal to shallow subtidal areas for spawning and rearing. Adults move from offshore waters to inshore holding areas prior to moving to spawning grounds (Lemberg et al. 1997). There are no documented

Pacific herring spawning grounds in any of the MHR study areas (spawning grounds have been documented in nearby Quartermaster Harbor, Port Orchard, and Port Susan); however, adult herring have been reported in all MHR areas at water depths ranging from 9 to 37 m (Quinnell and Schmitt 1991). Sand lance and surf smelt spawn in the intertidal zone at depths greater than +1.5 meters MLLW. Juveniles of both species rear in nearshore waters and adult surf smelt are pelagic and tend to stay in shallow subtidal habitats (Lemberg et al. 1997). There are documented sand lance and surf smelt spawning grounds in all three MHR areas (Bargmann 1998).

Fourteen species of rockfish have been proposed for coverage in the HCP. Very little is known about the early life history of most of these species because they are difficult to identify. Studies of the more common species (copper, quillback, and brown rockfish) indicate that shallow areas with eelgrass, kelp beds, and other vegetation on cobbles and boulders are utilized as nursery habitats. Upon reaching adult size, species such as brown, copper, yellowtail, quillback, black, redstripe, and yelloweye rockfish can be found in shallow subtidal as well as deep subtidal habitats. Adult greenstriped, black, and bocaccio rockfish are only found in deep subtidal habitats (Lamb and Edgell 1986). Brown, copper, and quillback rockfish have been documented in all three MHR areas (WDFW 2000). Yellowtail, black, redstripe, and yelloweye rockfish have been documented in the Brightwater Outfall Siting Area and the WTD Existing Discharges Area, but not in the Vashon Island Area. However, it is likely that these species occur in this area but have not been documented due to survey methods.

6.3 Deep Subtidal

The deep subtidal zone is the area in Puget Sound that lies below the level of light penetration and is characterized by narrow shelves and relatively steep slopes that flatten out into the deep central portions of the sound.

The shelf areas below the photic zone are in water depths ranging from 30 to 60 m. The narrow shelves consist primarily of medium to fine sand, intermixed with a small amount of gravel in shallow water, grading to silty sand with increasing water depth (EHI 1987, Tetra Tech 1990, Striplin et al. 1990, 1991,1993). Areas with rocky outcroppings can be found in the vicinity of points and headlands.

The slope depths (~60-150 m) are difficult to characterize because in many areas their steepness precludes the use of standard sampling equipment. This includes many locations in the MHR study area. In areas where surveys can be easily conducted (i.e., outer Elliott Bay), the sediments consist of sand with various amounts of silt, depending on the slope. In areas with fairly steep slopes, the sediments consist of silt, often overlying hard clay (Word et al. 1984a).

The slope of Puget Sound generally flattens out at water depths of 150 m. In these water depths the sediments consist of silt with clay. The exceptions to this general observation can be found at the bases of points (i.e., West, Alki, Three

Tree Points) where bottom currents are swift enough that fine silts do not settle (Word et al. 1984a, 1984b).

All three of these areas contain wide and varied communities of epifaunal and infaunal invertebrates as described in Sections 3.0 , 4.0 and 5.0. Many of these invertebrates, primarily polychaete worms and epifaunal ostracods, are prey items that may be used by the HCP species that feed on or near the sediment surface (cods, pollocks, and sturgeons). In other cases, these and other invertebrate species are two or three tiers lower in the food web than the HCP species and so do not have a direct connection. Some of the data necessary to make these connections can be found in Appendix A in the compilation of existing fish food web data (Cordell 2000). However, more information is needed before we can adequately answer how or if the species in deep subtidal benthic communities affect the food webs leading to the HCP proposed species of concern.

Marine mammals, Orcas and Steller sea lions utilize the deep subtidal in their search for prey and as a pathway to other feeding and/or resting areas. Orcas have been sighted in deep subtidal areas in all three study areas, particularly in the fall months (K. Koski, Whale Museum, pers. comm.). Steller sea lions may use the deep subtidal zone in all three areas for feeding or as a migratory pathway (Gearin et al. 1999).

Of the three marine birds proposed for coverage in the HCP, only the common murre dives regularly to deep subtidal depths in search of food (Ehrlich et al. 1998). There have been documented sightings of common murres at the water surface over deep subtidal depths in all three study areas (WDFW 2000). Murres are presumably feeding in these areas.

Juvenile salmonids do not utilize deep subtidal areas to forage for food. As adults, chinook salmon commonly forage in deep subtidal areas. Chinook salmon have been observed by anglers to feed along the moving tide lines where the sediment is stirred up, disturbing demersal fish and epibenthic invertebrates (J. Word, MEC Environmental, pers. comm.). Although there is no documentation, it is likely that adult chinook salmon feed along the tide lines in all three MHR study areas. The other salmonid species generally feed in the upper layers of the water column (less than 50 m) and may forage at deep subtidal depths only on occasion (Healey 1980). Salmonids returning to inside waters do not appear to use deep subtidal depths (Quinn et al. 1989).

Very little is known about the life history or distribution of Pacific and river lampreys in the deep subtidal. Since they act as scavengers as well as parasites, it is likely they inhabit the deep subtidal where they may feed on the remains of fish. Numerous salmonid species have lamprey scars and it is possible those fish encountered the lampreys at depth. However, there was no information confirming lamprey presence in the deep subtidal in any of the three study areas.

As stated previously, there is little information on distribution of either green or white sturgeons in inland Puget Sound waters. However, there is no indication that either of these species feed or occur in deep subtidal waters.

Pacific cod and walleye pollock were found in all three MHR study areas in deep subtidal areas (WDFW 2000). Pacific cod adults are demersal and generally found in the deep subtidal; however, as stated in the previous section, they will also feed in shallow areas (West 1997). Walleye pollock adults are also demersal and use the deep subtidal region to feed and spawn. Juvenile Pacific hake use nearshore and shallow subtidal areas for rearing before moving into deeper subtidal waters. Adult hake were found in deep subtidal areas in all three MHR study areas (WDFW 2000). Adult lingcod are demersal and are found in shallow subtidal to deep subtidal rocky habitats throughout Puget Sound. Although lingcod were not found in deep subtidal areas in any of the three study areas, it is probable they do occur in these areas. Their absence in these areas is likely a reflection of sampling methods, as lingcod hide in rocks and crevices which are difficult to sample.

Three of the four forage fish species proposed for coverage in the HCP (Pacific herring, sand lance, and surf smelt) utilize nearshore habitats and there is no indication that they utilize deep subtidal areas (Lemberg et al. 1997). As stated previously, there is little information on habitat usage for eulachon.

Of the 14 rockfish species proposed for coverage in the HCP, adult brown, copper, yellowtail, quillback, black, redstripe, and yelloweye rockfish can be found in both shallow subtidal as well as deep subtidal habitats. Adult greenstriped, black, and bocaccio rockfish are only found in deep subtidal habitats (Lamb and Edgell 1986). The quillback rockfish was the only species found in deep subtidal waters during WDFW (2000) trawl and video surveys in any of the three MHR areas. Quillback were found in deep subtidal areas for all three study areas. However, the lack of other rockfish species in deep subtidal areas is likely a reflection of sampling methods and does not preclude their presence in these areas.

6.4 Major Data Gaps

Key data gaps for several of the species proposed for coverage in this report are listed below. Unless otherwise noted, the information applies to all three areas covered in this report.

Most of the abundance and distribution data for marine birds (common murre, marbled murrelet, and harlequin duck) are based upon seasonal aerial and land surveys and are dependent upon favorable sighting conditions, time of year surveyed, species wariness, and location surveyed. As a result, abundance of these birds may be underestimated. There are no major data gaps for the three marine mammals discussed in this report: Orcas, harbor porpoises, and Steller sea lions.

While there are no major data gaps for the northern abalone, information on isolated occurrences of Olympia oysters in all three areas is lacking. Olympia oyster spawning populations are not expected in the study area.

There are many data gaps for the salmonid species proposed for coverage. There is little or no information regarding residence times within the areas covered in this report for all salmonid populations known to spawn in rivers and streams with outlets into central Puget Sound. There is limited information for chinook, chum, and coho salmon residence times in the WTD Existing Discharges Area and information on preferred habitat for feeding and rearing is limited. Depth distribution and habitat usage data for adult and juvenile salmonids in nearshore waters in all three areas are limited or nonexistent. There is very little information regarding abundance and distribution for bull trout in estuarine waters. The movement of cutthroat trout in estuarine waters and its distribution in all three areas covered in this report are not well known.

Little information is known regarding abundance and distribution of both species of lampreys (Pacific and river) and both species of sturgeon (green and white) in the HCP study area.

Possible spawning grounds for forage fish (Pacific herring, sand lance, and surf smelt) in most of the WTD Existing Discharges Area and the southern portion of the Brightwater Outfall Siting Area have not been extensively surveyed. Information regarding sand lance movements and distribution, other than during the spawning season, is also lacking as is basic ecological information for this species. Little information is known regarding eulachon in inland Puget Sound waters, including time of occurrence, distribution, and water depth requirements.

Most distribution data for fishes are based on trawl and video data and are dependent upon time of year, depth, and location sampled. Many pelagic fish are rarely documented in trawl surveys as this sampling method favors capturing semi-demersal or demersal fish. As a result, abundance and distribution data for fishes such as yellowtail, black, and bocaccio rockfish and forage fish may be underestimated. In addition, many rockfish species and lingcod hide in crevices and rocks and are difficult to sample with both video and trawl surveys. Rockfish species such as the greenstriped, black, and bocaccio rockfish are found in deep waters and are difficult to sample. As a result, the abundance and distribution information for these species may be underestimated. The absence of pelagic and other species difficult to sample with trawl and video data does not preclude those species from inhabiting waters in the study areas.

For the WTD Existing Discharges Area, Vashon Island Area, and the northernmost portion of the Brightwater Outfall Siting Area, there are data gaps regarding vegetation abundance and distribution in the low intertidal-shallow subtidal zone. The vegetation data for these areas were based upon aerial surveys, which were limited to the supralittoral and high to mid intertidal zones. Consequently, the full extent of eelgrass and kelp distribution in these areas is not known. In addition, the survey technique does not allow for the vegetation to be

analyzed on a small scale. Only generalizations can be made using the WDNR Shorezone Database.

Benthic fauna in intertidal and shallow subtidal nearshore areas of the Brightwater Outfall Siting Area and the Vashon Island Area have not been extensively surveyed, and little information is available regarding potential prey items in nearshore areas for the species proposed for coverage in the HCP. There have been several benthic fauna and salmonid prey studies in the WTD Existing Discharges Area, but general food web information in all study areas is lacking.

Limited habitat usage information is available for Colvos Passage in the Vashon Island Area. Forage fish spawning surveys and one video survey for fish distribution have been conducted within this area, but nearshore vegetation distribution and habitat usage by marine fish have not been studied.

Table 6-1. General summary of distribution, habitats, and relative abundance of proposed HCP marine species

Common Name	Scientific Name	Distribution in Puget Sound [a]	Primary Habitat in Puget Sound	Relative Abundance in Puget Sound [b]	Timing of Primary Occurrence (season)	Diet
Killer Whale (orca)	*Orcinus orca*	Areas 1,2,3: All of Puget Sound including the Central Basin; Vashon Island, Alki Point, Point Jefferson [1-6]	open water, active at water surface, they do not make prolonged deep dives [7]	common [1,3,4]	Summer, Fall [1,3,4]	Resident pods feed predominantly on fish including salmon, lingcod, rockfishes, flatfishes, and squid.[8]
Pacific Harbor Porpoise	*Phocoena phocoena*	No MHR Areas: From Cape Flattery through the Stait of Juan de Fuca and San Juan Islands. No sightings south of Admiralty inlet for several years [9,10]	coastal waters, including bays, estuaries and nearshore areas in waters less than 200 m [5,11]	rare [9,10,12]	Follow prey inshore to offshore with most moving seaward in Winter [13]	main prey includes schooling fishes (herring, smelt, pollock, whiting), squid, and crustaceans[11,12]
Steller Sea Lion	*Eumetopias jubatus*	Areas 1,2,3: Mainly coastal, San Juan Islands, and Stait of Juan de Fuca. Occasionally seen in both northern and southern Puget Sound[14]	Open water; prefer shallow waters and are often found foraging close to shore at night. Haul out sites include jetties and buoys. [14,15]	uncommon [14]	early fall to early spring [15]	Pacific whiting, herring, smelt, rockfish, skates, salmon, and squid [16]
Common Murre	*Uria aalge*	Areas 1,2,3: Common on islands off the coast. Frequent in San Juan Islands, Strait of Juan de Fuca and all of Puget Sound. [17]	Open water and rocky shores. Typically dive to 20-30 m when feeding [18]	common [17]	late summer and fall [17]	Small fish including sandlance, herring, smelt and bottomfish. Worms and other invertebrates [17,18]
Harlequin Duck	*Histrionicus histrionicus*	Areas 1,2,3: Common in Strait of Juan de Fuca and north; few south of Admiralty Inlet. Found in north and south Puget Sound when occur [17,19]	rivers and streams for breeding, coastlines and shallow intertidal areas [20]	common [19,20]	October to May [17]	intertidal and subtidal marine invertebrates, particularly crabs, amphipods, and snails. Occasionally small fish and fish roe [20]
Marbled Murrelet	*Brachyramphus marmoratus*	Areas 1,2,3: Common winter visitor in the Strait of Juan de Fuca, San Juan Islands but a rarer visitor to Puget Sound. [17,19]	nearshore waters and areas within 5 km of shore in waters less than 60 m deep [21]	uncommon [19]	fall and winter [17]	opportunistic, small schooling fish (sandlance, herring, smelt), sea perch, crustaceans, mollusks, and squid [21]

Table 6-1. General summary of distribution, habitats, and relative abundance of proposed HCP marine species

Common Name	Scientific Name	Distribution in Puget Sound [a]	Primary Habitat in Puget Sound	Relative Abundance in Puget Sound [b]	Timing of Primary Occurrence (season)	Diet
Bull Trout	*Salvelinus confluentus*	Areas 1,2, possibly 3: Marine distribution not known, Green River, Cedar River, Skagit River, Skykomish River, Hood Canal [22]	streams, lakes, mouth of rivers, marine habitat includes estuarine and nearshore areas [22,23]	not readily available [24]	estuarine waters in spring to mid summer [22]	adults opportunistic, feed on fish (salmonids and bait fish); juveniles feed on insects, zooplankton, amphipods, mysids, small fish [23,25,26]
Chinook Salmon	*Oncorhynchus tschawytscha*	Areas 1,2,3: most major rivers in north and south Puget Sound, including Duwamish/Green River [27]	intertidal and subtidal habitats including, nearshore areas [27,28]	stock dependent [27]	spring, summer,and fall [27]	adults opportunistic, feed on fish (salmonids and bait fish), squid; juveniles feed on insects, zooplankton, amphipods, small fish [29,30]
Chum Salmon	*Oncorhynchus keta*	Areas 1,2,3: most major rivers in north and south Puget Sound, including Duwamish/Green River [31]	shallow waters near tidal marshes, eelgrass meadows, and tideflats [31]	stock dependent [31]	fall, winter, spring [31]	adults opportunistic, feed on fish (salmonids and bait fish); juveniles feed on insects, zooplankton, amphipods, small fish [29,30]
Coho Salmon	*Oncorhynchus kisutch*	Areas 1,2,3: most major rivers in north and south Puget Sound, including Duwamish/Green River [32]	not well known, juveniles both subtidal and nearshore habitats including eelgrass meadows and tideflats, adults epipelagic [29, 32]	stock dependent [32]	fall and peak outmigration in May [32]	adults opportunistic, feed on fish (salmonids and bait fish), scorpaenids; juveniles feed on insects, zooplankton, amphipods, small fish [29,30,33]
Cutthroat Trout	*Oncorhynchus clarki*	Areas 1,2,3: most major rivers emptying into Puget Sound, including Lake Washington system [34]	juveniles and adults can be found over a variety of substrates in both nearshore and offshore waters [29,35]	not well known [34]	fall, winter [29]	northern anchovy, kelp greenling, scorpaenids, salmonids, euphausiids, mysids and crab megalopae [29]

Table 6-1. General summary of distribution, habitats, and relative abundance of proposed HCP marine species

Common Name	Scientific Name	Distribution in Puget Sound [a]	Primary Habitat in Puget Sound	Relative Abundance in Puget Sound [b]	Timing of Primary Occurrence (season)	Diet
Sockeye Salmon	*Oncorhynchus nerka*	Areas 1,2,3: northern and central Puget Sound, including Lake Washington and Cedar River [36]	in marine waters, juveniles and adults found near gravel substrate, juveniles use nearshore areas [36]	not readily available	summer, fall [29]	juveniles feed on fish larvae, juvenile shrimp, insects, amphipods, mysids and euphausiids, adults feed on fishes [29, 36]
Steelhead	*Oncorhynchus mykiss*	Areas 1,2,3: most major rivers in Puget Sound [37]	Adults are epipelagic and found in coastal waters, usually in upper 12.5 m of the water column to a depth of 25m [37]	not readily available	winter, spring [29]	in marine waters juveniles and adults eat fish, crustaceans, squid, herring and amphipods [29,37]
Pacific Lamprey	*Entosphenus tridentatus*	detailed ditribution not available for Washington, however may spawn and rear in major Puget Sound rivers and streams [38]	juveniles in streams, estuarine channels; adults in open marine waters [38]	not known	spring, summer [38]	juveniles feed on diatoms, protozoa and invertebrates; adults parasitic on fish and marine mammals [35,38,39]
River Lamprey	*Lampetra ayresi*	detailed ditribution not available for Washington, however may spawn and rear in major Puget Sound rivers and streams [38]	juveniles in streams, estuarine channels; adults in open marine waters [38]	not known	spring, summer [38]	juveniles feed on diatoms, protozoa and invertebrates; adults parasitic on fish and marine mammals [35,38,39]
Northern Abalone	*Haliotis kamtschatkana*	No MHR Areas: Straits, San Juan Islands, and northern Puget Sound [40,41]	Typically nearshore rocky substrate at subtidal depths from 10 to 15 m [42]	uncommon [40]	all	juveniles feed on coralline algae, diatoms, and bacterial films;adults brown algae [41,43]
Olympia Oyster	*Ostrea conchaphila*	Areas 1,2,3 possibly: primarily southern Puget Sound [44]	intertidal and subtidal habitats including, mud flats, bays, and estuaries; rocks and gravel [42,45]	not available	all	filter feeder, detritus and planktonic algae [46]
Green Sturgeon	*Acipenser medirostris*	MHR Areas not known: Strait of Juan de Fuca [47]	juveniles in shallow water of high-flow rivers and estuaries; adults reside in subtidal marine areas [29]	rare [29]	not known	adults and larger juveniles feed on benthic and epibenthic invertebrates, small fish [29]

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White Sturgeon	*Acipenser transmontanus*	Areas 1,2: Strait of Juan de Fuca, Port Orchard, Seattle area, South Puget Sound, Hood Canal [47,48]	young juveniles are riverine; older juveniles and adults reside in rivers, estuaries, and ocean waters; mostly subtidal in estuarine habitat [29]	rare [29]	not known	juveniles and adults feed on benthic invertebrates (including shrimp and bivalves); adults feed on benthic invertebrates, eulachon and anchovy [29]
Pacific Cod	*Gadus macrocephalus*	Areas 1,2,3: most areas in Puget Sound but most abundant in northern areas [49]	variety of habitats, juveniles use eelgrass and adults demersal; water depths 50 to 200 m [49]	seasonally abundant [49]	most abundant during fall through early spring [49]	juveniels feed on crabs, shrimp, snails; adults feed on shrimp, benthic and pelagic fishes [50,51]
Walleye Pollock	*Theragra chalcogramma*	Areas 1,2,3: throughout Puget Sound [47,49,51]	juveniles shallow, nearshore area; adults depper waters near sandy or muddy bottoms [49,51]	seasonally abundant [51]	spawning aggregations in late winter/ spring [49,51]	juveniles feed mostly on crustaceans; adults small fishes [49]
Pacific Hake	*Merluccius productus*	Areas 1,2,3: throughout Puget Sound but more common in central and south Puget Sound [47]	predominantly in mid-water column, deep water to 980m [49,51]	common [47]	all year [49]	juveniles feed on planktonic crustaceans; adults shrimp, sand lance, herring, and other small fish [49]
Lingcod	*Ophiodon elongatus*	Areas 1,2,3: throughout most of Puget Sound [50]	juveniles nearshore areas near kelp, eelgrass; adults rocky locations usually less than 100 m [52]	common [53]	all year [48]	juveniels feed on pelagic crustaceans, fish larvae; adults feed on fish (mainly juvenile rockfish), cephalopods, and crustaceans [52]
Pacific Herring	*Clupea harengus pallasi*	Areas 1,2,3: throughout Puget Sound [54]	large schools in shallow bays and nearshore areas and also throughout water column [55]	common [47,53]	all year [54]	juveniles feed on zooplankton and phytoplankton; adult diet not well known [56]
Sand Lance	*Ammodytes hexapterus*	Areas 1,2,3: throughout Puget Sound [54]	rear in bays and nearshore waters; open nearshore waters during day and burrow in bottom at night [55]	common [54]	all year [54]	juveniles feed on diatoms, copepods, copepod nauplii; adult diet not well known [29]

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Surf Smelt	*Hypomesus pretiosus*	Areas 1,2,3: throughout Puget Sound [54]	rear in nearshore areas; adults tend to inhabit nearshore areas and remain close to bottom at all times [54]	abundant [55]	all year [48]	juveniles feed on planktonic organisms; adults feed on planktonic crustaceans, fish larvae, combjellies [57]
Eulachon	*Thaleichthys pacificus*	MHR Areas not known: mainly northern Puget Sound (the Straits and San Juan Islands) but not well known [54]	close to bottom in ocean waters most of life, spawn in rivers [29,54]	uncommon [47]	spawn from winter to spring [54]	larvae eat phytoplankton and small zooplankton; juveniles and adults eat planktonic crustaceans (euphausiids, copepods) [29,35]
Brown Rockfish	*Sebastes auriculatus*	Areas 1,2,3: throughout most of Puget Sound [47]	shallow rocky nearshore areas and offshore areas over rocks; remains on or close to bottom at depths to 128 m [58]	common [53,59]	all year [58]	crab, shrimp, small fish, isopods, and polychaetes [58]
Copper Rockfish	*Sebastes caurinus*	Areas 1,2,3: throughout Puget Sound [58,59]	adults demersal in rocky areas; juveniles found in nearshore areas in kelp beds [50,58]	common [59]	all year [58]	juveniles eat copepods, other zooplankton and amphipods;adults benthic feeders on crustaceans, fish, and molluscs [58]
Greenstriped Rockfish	*Sebastes elongatus*	Areas 1,2,3: throughout Puget Sound [47]	deep, level, mostly sandy bottoms [51]	uncommon [47,59]	not known	not known, probably opportunistic
Widow Rockfish	*Sebastes entomelus*	No MHR Areas: not found in inland Puget Sound, only found along outer coasts and Straits [59, 60]	midwater above rocky reef or steep shoreline [35,50]	rare, if at all [59,60]	not applicable	plankton, small fish [35]
Yellowtail Rockfish	*Sebastes flavidus*	Areas 1,2,3: throughout Puget Sound [47]	shallow open water along steeply sloping shores or above rocky reefs [50]	common [53,59]	adults all year [59]	small fish, crustaceans, squid [35]

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Quillback Rockfish	*Sebastes maliger*	Areas 1,2,3: throughout Puget Sound [59,61]	rocky reefs and hard, even bottoms between 15m and 275m, found at or near bottom [35,50,59]	common [53,59]	all year [59]	amphipods, crabs, shrimp, snails, fish (herring, sand lance) [57]
Black Rockfish	*Sebastes melanops*	Areas 1,2,3: mainly north and central Puget Sound [61,62]	water column over rocky reefs and shores to 360m but most abundant in waters less than 54 m [50,58]	fairly common [62]	not known	adults feed on herring and other fish (smelt, anchovies), and squid; juveniles feed on zooplankton [58]
Blue Rockfish	*Sebastes mystinus*	No MHR Areas: not found in inland Puget Sound, only found along outer coasts and Straits [59, 60]	water column over rocky reefs and shores to 360m [35]	rare, if at all [59,60]	not applicable	tunicates, jellies, fish [35]
China Rockfish	*Sebastes nebulosus*	No MHR Areas: not found in inland Puget Sound, only found along outer coasts and Straits [59, 60]	exposed rocky shores or reefs less than 126m [50]	rare, if at all [59,60]	not applicable	not known, probably opportunistic
Tiger Rockfish	*Sebastes nigrocinctus*	No MHR Areas: not found in inland Puget Sound, only found along outer coasts and Straits [59, 60]	rocky reefs between 10 and 275m [50]	rare, if at all [59,60]	not applicable	not known, probably opportunistic
Bocaccio	*Sebastes paucispinus*	MHR Areas not known: mianly outer coasts and Straits, occassionally north and central Puget Sound [59,63]	open water adjacent to deep reefs to 300m [50]	uncommon [47,53,59]	not known	small fish [35]
Canary Rockfish	*Sebastes pinniger*	No MHR Areas: mainly outer coasts and Straits, occassionally north Puget Sound and Hood Canal [59]	rocky areas at various depths at least 360m; juveniels inhabit shallow waters [50,59]	uncommon [59]	not known	not known, probably opportunistic

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Redstripe Rockfish	*Sebastes proriger*	Areas 1,2,3: north and central Puget Sound, probably south Puget Sound [47,59,61]	rocky reefs and steep silt-covered cliff faces meet gently sloping sandy or muddy bottoms deeper than 25m [50]	fairly common [59]	not known	not known, probably opportunistic
Yelloweye Rockfish	*Sebastes ruberrimus*	Areas 1,2,3: throughout Puget Sound [47,59]	steep-faced rocky reefs' offshore pinnacles and boulder fields, adults usually deeper than 30 m [50,57,59]	fairly common [59]	not known	shrimp, fish (gadids, sand lance, herring, juvenile rockfishes),crabs, and snails [57,59]

Table notes and references

[a] Area 1: NTF Outfall Siting Area
Area 2: WTD Existing Discharge Area
Area 3: Vashon Island Area

[b] Abundant-often seen or caught in groups
Common-often seen or caught
Uncommon-occasionally seen or caught
Rare-few reported observations

1 Balcomb 1982
2 Balcomb,K. & C. Goebal 1976
3 Balcomb et al. 1980
4 Olesiuket al. 1990
5 Forney et al. 1999
6 Forney et al. 2000
7 Baird et al. 1998
8 Ford et al. 1994
9 B. Hanson, NMML, pers. comm.
10 Calambokidis et al. 1992
11 Leatherwood and Reeves 1983
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15 Reeves et al. 1992
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17 Angell and Balcomb 1982
18 Ehrlich et al. 1988
19 WDFW 2000
20 Robertson and Goudie 1999
21 Nelson 1997
22 WDFW 1998
23 Kraemer 1994
24 King County 2000
25 Rieman and McIntyre 1993
26 McPhail and Baxter 1996
27 Myers et al. 1998
28 Shreffler et al. 1990
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37 Pauley et al. 1986
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40 R. Anderson, Seattle Aquarium, pers. comm.
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49 Wilson et al. 1994
50 Lamb and Edgell 1986
51 West 1997
52 Shaw and Hassler 1989
53 Sommerton and Murray 1976
54 Bargmann 1998
55 WDFW 1997
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62 Pacunski and Palsson 1998
63 Stober and Pierson 1984